VI. CLAIMS

What is claimed is:

1. A composition comprising a nucleic acid wherein the nucleic acid comprises a sequence encoding a HEX-α and a sequence encoding a HEX-β.
2. The composition of claim 1, wherein the sequence encoding the HEX-β is orientated 5' to the sequence encoding HEX-α.
3. The composition of claim 1, further comprising a promoter.
4. The composition of claim 1, further comprising an integrated ribosomal entry site (IRES).
5. The composition of claim 4, wherein the sequence encoding the HEX-β is orientated 5' to the IRES sequence and the IRES sequence is located 5' to the sequence encoding HEX-α.
6. The composition of claim 4, further comprising a promoter.
7. The composition of claim 6, wherein the promoter is located 5' to the sequence encoding the HEX-β and the sequence encoding the HEX-β is orientated 5' to the IRES sequence and the IRES sequence is located 5' to the sequence encoding HEX-α.
8. The composition of claim 6, wherein the parts are oriented 5'-promoter-HEX-β encoding sequence-IRES- HEX-α encoding sequence-3'.
9. The composition of claim 6, wherein the parts are oriented 5'-promoter-HEX-α encoding sequence -IRES- HEX-β encoding sequence -3'.
10. The composition of claim 6, wherein the nucleic acid comprises a second IRES sequence.
11. The composition of claim 10, wherein the second IRES sequence is located 3' to the other parts.
12. The composition of claim 6, wherein the HEX-β has at least 70%, 75%, 80%, 85%, 90%, or 95% identity to the sequence set forth in SEQ ID NO:3 and the HEX-α has at least 70%, 75%, 80%, 85%, 90%, or 95% identity to

the sequence set forth in SEQ ID NO:1.

13. The composition of claim 12, wherein any change from SEQ ID NO:3 or SEQ ID NO:1 is a conservative change.

14. The composition of claim 13 wherein the HEX-β has the sequence set forth in SEQ ID NO:3 and the HEX-α has the sequence set forth in SEQ ID NO:1.

15. The composition of claim 6, wherein the sequence encoding HEX-β hybridizes to SEQ ID NO:2 under stringent conditions and wherein the HEX-α element hybridizes to SEQ ID NO:4 under stringent conditions.

16. The composition of claim 12, wherein the IRES sequence comprises a sequence having at least 70%, 75%, 80%, 85%, 90%, or 95% identity to the sequence set forth in SEQ ID NO:5.

17. The composition of claim 16, wherein the promoter sequence comprises a constitutive promoter.

18. The composition of claim 17, wherein the promoter sequence comprises a CMV promoter.

19. The composition of claim 18, wherein the CMV promoter comprises the sequence set forth in SEQID NO:32.

20. The composition of claim 16, wherein the promoter sequence comprises a beta actin promoter.

21. The composition of claim 20, wherein the beta actin promoter sequence comprises an avian beta actin promoter sequence.

22. The compositin of claim 21, wherein the beta actin promoter sequence comprises a mammalian beta actin promoter sequence.

23. The composition of claim 21, wherein the beta actin promoter comprises the sequence set forth in SEQ ID NO:26.

24. The composition of claim 16, wherein the promoter sequence comprises an inducible promoter.

25. The composition of claim 18, wherein the promoter sequence further comprises a beta actin promoter.

26. The composition of claim 6, wherein the composition produces a functional HEXB product.

27. The composition of claim 6, wherein the composition produces a functional HEXA product.

28. The composition of claim 6, wherein the composition produces a functional HEXS product.

29. The composition of claim 26, wherein the composition is capable of cross correcting.

30. The composition of claim 26, wherein the function is the catabolism of GM2 gangliosides in mammalian cells.

31. The composition of claim 6, wherein the nucleic acid further comprises a reporter gene.

32. The composition of claim 31, wherein the reporter gene is a lacZ gene.

33. The composition of claim 31, wherein the reporter gene is flanked by recombinase sites.

34. The composition of claim 33, wherein the recombinase sites are for the cre recombinase.

35. The composition of claim 6, wherein the nucleic acid further comprises a transcription termination site.

36. The composition of claim 35, wherein the transcription termination site is oriented 5' to the promoter sequence.

37. The composition of claim 36, wherein the transcription termination site is flanked by recombinase sites.

38. The composition of claim 37, wherein the recombinase sites are for the cre recombinase.

39. The composition of claim 6, further comprising a vector.

40. The composition of claim 39, wherein the vector comprises a lentiviral vector.

41. The composition of claim 40, wherein the lentiviral vector comprises a feline

immunodeficiency virus.

42. The composition of clam 40, wherein the lentiviral vector comprises a human immunodeficiency virus.

43. The composition of claim 39, wherein the vector can be stably integrated for at least three months.

44. A composition comprising a cell wherein the cell comprises the nucleic acid of claim 6.

45. A composition comprising a cell wherein the cell comprises the vector of claim 39.

46. The composition of claim 47, wherein the cell comprises a neuron, glia cell, fibroblast, chondrocyte, osteocyte, endothelial cell, or hepatocyte.

47. The composition of claims 6, wherein the composition is in pharmaceutically acceptable form.

48. The composition of claims 6, wherein the composition is in an effective dosage.

49. The composition of claim 48, wherein the effective dosage is determined as a dosage that reduces the effects of Tay Sachs or Sandoff's disease.

50. A composition comprising an animal wherein the animal comprises the vector of claim 39.

51. A composition comprising an animal wherein the animal comprises the nucleic acid of claim 6.

52. A composition comprising an animal wherein the animal comprises the cell of claim 45.

53. The composition of claim 50, wherein the animal is mammal.

54. The composition of claim 53, wherein the mammal is a murine, ungulate, or non-human primate.

55. The method of claim 54, wherein the mammal is a mouse, rat, rabbit, cow, sheep, or pig.

56. The composition of claim 54, wherein the mammal is mouse.

57. The composition of claim 56, wherein the mouse comprises a HexB knockout.

58. Thecomposition of claim 56, wherein the mouse comprises a HexA knockout.

59. The composition of claim 58, wherein the mouse further comprises a HexB knockout.

60. The composition of claim 54, wherein the mammal is a non-human primate.

61. A method of providing HEXA in a cell comprising transfecting the cell with the nucleic acids of claim 6.

62. A method of providing HEXB in a cell comprising transfecting the cell with the nucleic acids of claims 6.

63. A method of providing HEX-α and HEX-β in a cell comprising transfecting the cell with the nucleic acid of claim 6.

64. The method of claim 63, wherein the step of transfecting occurs in vitro.

65. The method of claim 63, wherein the step of transfecting occurs in vivo.

66. A method of providing HEXS in a cell comprising transfecting the cell with the nucleic acids of claim 6.

67. A method of making a transgenic organism comprising administering the nucleic acid of claim 6.

68. A method of making a transgenic organism comprising administering the vector of claim 39.

69. A method of making a transgenic organism comprising administering the cell of claims 45.

70. A method of making a transgenic organism comprising transfecting a lentiviral vector to the organism at during a perinatal stage of the organism's development.

71. A method of treating a subject having Tay Sachs disease and/or Sandoff

disease comprising administering the composition of claim 47.

72. A method of making a composition, the composition comprising a nucleic acid molecule, wherein the nucleic acid molecule is produced by the process comprising linking in an operative way a promoter element, an element comprising sequence encoding HEX-β, a IRES element, and an element encoding HEX-α.

73. The method of claim 72, wherein the HEX-β element comprises a sequence having at least 80% SEQ ID NO:1 and the HEX-α element comprises a sequence having at least 80% to SEQ ID NO:3.

74. The method of claim 73, wherein any change in SEQ ID NO:1 or SEQ ID NO:3 is a conservative change.

75. The method of claim 72, wherein the sequence encoding HEX-β hybridizes to SEQ ID NO:2 under stringent conditions and wherein the sequence encoding the HEX-α hybridizes to SEQ ID NO:4 under stringent conditions.

76. A method of producing a composition, the composition comprising a cell, the method comprising administering the nucleic acid of claim 6 to the cell.

77. A method of producing a composition, the composition comprising a peptide, the method comprising expressing the nucleic acid of claim 6.

78. The method of claim 77, further comprising isolating the peptide.

79. A method of producing a composition, the composition comprising an animal, the method comprising administering the nucleic acid of claim 6 to the animal.

80. The method of claim 79, wherein the animal is a mammal.

81. Wherein the mammal is a murine, ungulate, or non-human primate.

82. The method of claim 81, wherein the mammal is a mouse, rat, rabbit, cow, sheep, or pig.

83. A nucleic acid comprising a sequence encoding HEX-β wherein the HEX-β has the sequence set forth in SEQ ID NO:3, a sequence encoding HEX-α, wherein the HEX-α has the sequence set forth in SEQ ID NO:1, a

promoter, and an IRES sequence, wherein the promoter is located 5' to the sequence encoding the HEX-β and the sequence encoding the HEX-β is orientated 5' to the IRES sequence and the IRES sequence is located 5' to the sequence encoding HEX-α.

84. A composition comprising a nucleic acid wherein the nucleic acid comprises a sequence encoding a first HEX-β and a sequence encoding a second HEX-β.

85. A composition comprising a nucleic acid wherein the nucleic acid comprises a sequence encoding a first HEX-α and a sequence encoding a second HEX-α.

86. A composition comprising four parts: 1) a promoter, 2) a sequence encoding a HEX-α, 3) a sequence encoding a HEX-β, and 4) an integrated ribosomal entry site (IRES).

87. The composition of claim 6, wherein the promoter comprises a cell specific promoter.

88. The composition of claim 87, wherein the cell specific promoter comprises the Nuclear enolase specific (NSE) promoter.

89. The composition of claim 88, wherein the cell specific promoter comprises the sequence set forth in SEQ ID NO:69.

90. The composition of claim 87, wherein the cell specific promoter comprises the COLL1A1 promoter.

91. The composition of claim 90, wherein the cell specific promoter comprises the sequence set forth in SEQ ID NO:70 or SEQ ID NO:71.

92. A method of delivering a nucleic acid to a brain central nervous system cell comprising systemically administering a vector to the subject, wherein the vector transduces a blood cell, and wherein the blood cell fuses with a brain cell.

93. The method of claim 92, wherein the blood cell comprises a blood progenitor cell.

94. The method of claim 92, wherein the blood cell comprises a marker for a blood progenitor cell.

95. The method of claim 92, wherein the blood cell comprises an endothelial cell.

96. The method of claim 92, wherein the blood cell comprises a marker for an endothelial cell.

97. The method of claim 92, wherein the endothelial cell comprises a marker, wherein the marker is CD31.

98. The method of claim 92, wherein the blood cell comprises a microglia cell.

99. The method of claim 92, wherein the blood cell comprises a marker for a microglia cell.

100. The method of claim 92, wherein the blood cell comprises a monocyte cell.

101. The method of claim 92, wherein the blood cell comprises a marker for a monocyte cell.

102. The method of claim 92, wherein the blood cell comprises a macrophage.

103. The method of claim 92, wherein the blood cell comprises a marker for a macrophage cell.

104. The method of claim 92, wherein the blood cell comprises a marker wherein the marker is CD11b.

105. The method of claim 92, wherein the blood cell comprises a lymphocyte cell.

106. The method of claim 92, wherein the blood cell comprises a marker for a lymphocyte cell.

107. The method of claim 105, wherein the lymphocyte cell comprises a marker wherein the marker is CD3.

108. The method of claim 92, wherein the brain cell comprises a purkinje cell.

109. The method of claim 92, wherein the brain cell comprises a marker for a purkinje cell.

110. The method of claim 109, wherein the marker is calbindin for Prkinje cerebellar cells

111. The method of claim 92, further comprising, adding the vector to a blood cell ex vivo producing a transduced blood cell, and administering the transduced blood cell to the subject.

112. The method of claim 111, wherein the blood cell comprises a blood cell obtained from the subject or is derived from a blood cell obtained from the subject.

113. The method of claim 111, wherein the blood cell comprises a progenitor cell.

114. The method of claim 111, wherein the blood cell comprises a marker for a blood progenitor cell.

115. A method of delivering a vector to a brain cell comprising, administering the vector to a subject, wherein the vector directly transduces the brain cell.

116. The method of claim 115, wherein the vector comprises the nucleic acid of claim 6.

117. The method of claim 115, wherein the subject is a perinatal..

118. The method of claim 115, wherein the subject is a neonatal.

119. The method of claim 115, wherein the brain cell is a brain cortex cell, a brain basal ganglia cell, a brain thalamus cell, a brain cerebellum cell, or a brain stem cell.

120. The method of claim 115, wherein the administration of the vector comprises less than or equal to 10^3 infectious particles.

121. The method of claim 115, wherein the administration of the vector comprises less than or equal to 10^5 infectious particles.

122. The method of claim 115, wherein the administration of the vector

comprises less than or equal to 10^7 infectious particles.

123. The method of claim 115, wherein the administration of the vector comprises greater than or equal to 10^3 infectious particles.

124. The method of claim 115, wherein the administration of the vector comprises greater than or equal to 10^5 infectious particles.

125. The method of claim 115, wherein the administration of the vector comprises greater than or equal to 10^7 infectious particles.

126. The method of claim 115, wherein the administration of the vector comprises a m.o.i of about 2.

127. The method of claim 116, wherein the vector reduces the inflammation of the brain.

128. The method of claim 116, wherein the vector reduces the deteriation of motor function due to a lysomal storage disease.

129. The method of claim 128, wherein the lysomal storage disease involves GM_2 gangliodisose.

130. The method of claim 129, wherein the disease is Tay-Sachs disease.

131. The method of claim 129, wherein the disease is Sandoff's disease.

132. A method of delivering a vector to a brain cell comprising systemically administering a vector to a perinatal subject.